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Combined effect of hydro priming and root pruning on plant dry matter of tomato (*Lycopersicon esculentum*) seedlings

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Abstract

This study was conducted as completely randomized design with three replications on plant dry matter of tomato seedling at Bioresources Development Centre, Odi, Bayelsa State, Nigeria. The factor of study included different time hydro priming (control, 24 h, 48 h, 72 h and 96h) and afterwards roots were pruned 25 DAS (rps 1/3-25 DAS and 2/3-25 DAS) and 32 DAS seedlings (rps 1/3-22 DAS and 2/3-32 DAS). The characters measured were: total plant dry matter, dry leaf weight, dry stem weight, dry root weight and root: shoot ratio of mean, min, max and CV. The results showed that hydropriming and root pruning significantly affected the growth of tomato seedlings. The total plant dry matter (W) of non root pruned seedlings for all primed seeds was significantly higher compared with primed seed with root pruned. The highest average dry matter (1.15g and 1.17g) was obtained from seeds primed for 96h (rps 1/3-25DAS and nps 32 DAS respectively) while the lowest average dry matter (0.37g and 0.34g) was obtained from seeds primed for 96h (rps 2/3-25 DAS and same 96h rps 2/3-32 DAS respectively). Mean comparison of root-shoot ratio pruned for 96hrs (rps 2/3-25DAS) and 72hrs (rps 2/3-32 DAS) showed the highest and lowest mean ratio respectively. Leaf and stem weight of all primed seeds including control all exhibited significant variations irrespective of the severity of root pruning and days after sowing. The results demonstrated that the interaction between the different hydropriming duration and root pruning of varying severity of tomato seedlings had significant effect on its plant dry matter.

Key words: Hydro priming, pruning, Seedling dry weight and Tomato.

INTRODUCTION:

Seed priming is pre-sowing treatment used as a technique to enhance seed performance, notably with respect to rate and uniformity of germination [1], thereby improving seedling stand and enabling better crop establishment [2]. The most common seed priming treatments used to increase seed germination and synchronization are osmopriming (immersing the seeds in solutions with osmotic potential), halopriming (placing the seeds in salt solution), hydropriming (placing the seeds in water), matpriming (placing the seeds between saturated jute mat layers) and hardening (alternately soaking and drying the seeds)[3, 4, 5]. Hydro-priming is a special type of seed priming in which seeds are soaked in water and dried before sowing to

accomplish seed hydration [6]. Studies by Ghassemi-Golezani *et al.*, (2008) [7] show that hydropriming treatments increased the weight of the seedling root, the germination rate, as well as shoot, root and seedling dry weight. Hydropriming has been described as a very important seed treatment technique which results in rapid germination and uniform stand establishment in various crops [8].

Root tangling and root spiraling is one of the major challenge associated with conventional containerized plant production is. Air pruning [9] and chemical pruning [10] were experimented as alternatives to overcome problems related with root tangling

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and spiralling and improve stand establishment rate of vegetable seedlings. Pruning part of the root system leads to reduced water and mineral uptake, and a reduction in top growth in one side, but on the other side it favors the use of stored carbohydrates for root growth until the equilibrium has been restored [11]. Well-developed and well-structured root systems with numerous lateral roots are one of the most essential attributes of high quality seedlings [12].

The root system plays a fundamental role in taking nutrients and water, and as the absorption at the root level is more intense, the higher the biomass, hence higher yield. High root-shoot ratio indicates a greater root density and root interception for nutrient uptake. High degree of pruning can result in an imbalance. Priming can make any imbalance tolerable, hence, this treatment can change the root-shoot ratio. The aim of this study is to investigate the effects of hydro-priming duration and root pruning of different severity on the plant dry matter of tomato seedlings.

MATERIALS AND METHOD

Seed materials and priming treatments

This study was conducted Bioresources Development Centre, Odi, Bayelsa State with seeds of indeterminate tomatoes.

The tomato (*Lycopersicon esculentum*) seeds were soaked in distilled water for 24hrs, 48hrs, 72hrs and 96hrs at room temperature. The primed seeds were dried back to their original state on a filter paper. Un-primed seeds served as control. All primed seeds were then removed from the priming media and the surface sterilized (including control

seeds) with 2% sodium hypochlorite (NaOH). After the surface sterilization, seeds were washed with distilled water and dried on paper towels at room temperature, under ventilated conditions, until they regained their original moisture content [7].

Pruning

Seeds from each of the treatments were sown in nursery bags with same nursery mixture of soil and were divided into five groups with each group containing seeds primed for different duration (control, 24, 48, 72 and 96h). Twenty-five days after sowing, 1/3 and 2/3 of their root system were removed by mechanical pruning for the first (rps 1/3-25 DAS) and second group (rps 2/3-25 DAS) respectively, pruned seedlings were subsequently replanted into similar nursery bags. One week later (32 DAS), the same procedure was applied to the third (rps 1/3-32 DAS) and fourth group (rps 2/3-32 DAS) respectively. Rest of the plants (nps) were continuously grown in their initial nursery bags. At the end of the nursery period, 10 plants were randomly harvested from each experimental plot.

Root, stems and leaf dry matter for each plant were dried separately at 80°C and weighed

Statistical analysis

Data were analyzed using a completely randomized design. Analysis of variance (ANOVA) was carried out to evaluate the effects of hydro priming and root pruning on the total dry weight and root dry weight. Basic statistic parameters (mean, minimum and maximum and coefficient of variation) were also carried out on the root-shoot ratio. Duncan's multiple range test was used to compare the differences among treatment means.

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Table 1. Total plant dry matter (W), and root dry matter (RW) of tomato seedlings 25 and 32 days after sowing (DAS), according to the duration of hydropriming and type of pruning of seedlings (nps, rps 1/3, rps 2/3).

Growth Parameter	PRIMING DURATION	25 DAS			32 DAS	
	(hrs)	nps	rps 1/3	rps 2/3	rps 1/3	rps 2/3
W (g pl ⁻¹)	0	0.88 ^{a*}	0.69 ^b	0.69 ^b	0.67 ^b	0.66 ^b
RW (g pl ⁻¹)		0.07 ^a	0.06 ^b	0.04 ^c	0.04 ^c	0.03 ^d
W (g pl ⁻¹)	24	1.20 ^a	0.85 ^b	0.51 ^c	0.82 ^b	0.47 ^d
RW (g pl ⁻¹)		0.08 ^a	0.05 ^b	0.04 ^c	0.04 ^c	0.02 ^d
W (g pl ⁻¹)	48	0.83 ^a	0.73 ^{bc}	0.75 ^b	0.69 ^c	0.71 ^{bc}
RW (g pl ⁻¹)		0.08 ^a	0.08 ^a	0.06 ^b	0.06 ^{bc}	0.04 ^c
W (g pl ⁻¹)	72	0.86 ^a	0.70 ^{bc}	0.73 ^b	0.66 ^c	0.69 ^{bc}
RW (g pl ⁻¹)		0.06 ^a	0.05 ^b	0.04 ^{bc}	0.03 ^{cd}	0.03 ^d
W (g pl ⁻¹)	96	1.15 ^a	0.56 ^b	0.37 ^c	0.53 ^b	0.34 ^c
RW (g pl ⁻¹)		0.07 ^a	0.07 ^a	0.05 ^b	0.05 ^b	0.04 ^b

*Mean values of 10 plants, different letters within the same row indicate significant differences at P<0.05.

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Table 2. Root-shoot ratio (%) and descriptive statistics [minimum (Min), maximum (Max) and coefficient of variation (CV)] in tomato seedlings at 25 and 32 DAS, according to the duration of hydropriming and severity of root pruning (nps, rps 1/3, rps 2/3)

Root/Shoot %																		Min								Max								CV							
Priming Duration	25		32		25		32		25		32		25		32		25		32																						
	n	rps1/ 3	rps2/ 3	rps1/ 3	rps2/ 3	rps1/ 3	rps2/ 3	rps1/ 3	rps2/ 3	rps1/ 3	rps2/ 3	rps1/ 3	rps2/ 3	rps1/ 3	rps2/ 3	rps1/ 3	rps2/ 3																								
0	8.73	6.41	6.33	4.53	5.80	3.90	4.55	2.67	11.48	9.26	8.20	7.55	21.83	28.10	20.9	39.42	9																								
24	6.56	7.91	5.05	5.23	4.44	6.00	3.53	2.27	10.67	11.11	9.59	9.30	32.67	25.34	36.6	43.16	8																								
48	11.92	8.95	9.04	6.54	9.84	6.35	6.45	3.33	15.63	12.50	11.48	10.29	16.44	24.97	18.50	35.18																									
72	7.08	5.69	5.32	4.10	6.06	4.41	3.39	2.78	8.62	7.94	7.27	6.56	11.87	19.68	25.81	33.52																									
96	13.29	16.05	10.50	13.27	10.0	11.43	7.84	6.06	21.05	21.21	17.14	20.0	24.81	20.34	25.17	29.14																									
																		0																							
																		0																							
CV-coefficient of variation (%)																																									

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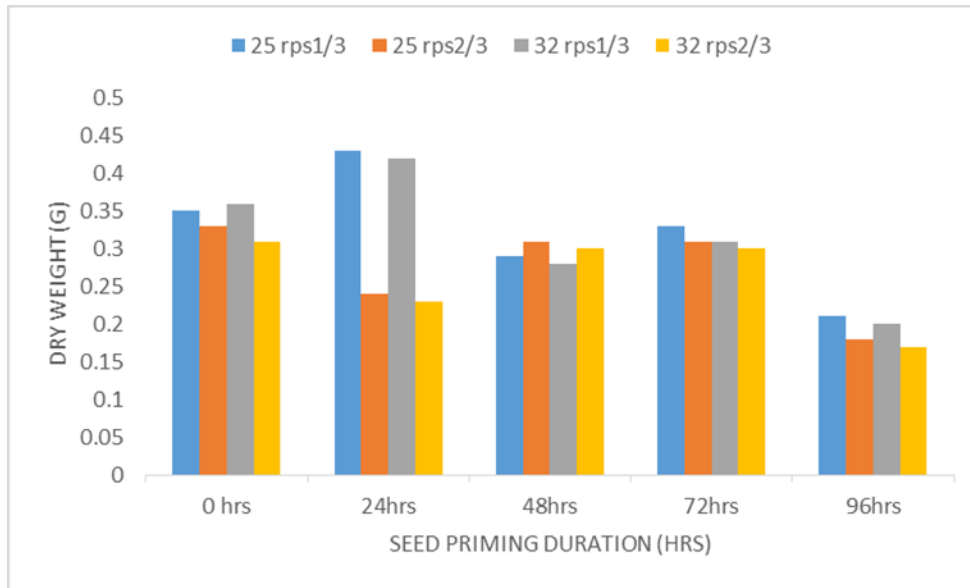


Fig. 1. Mean dry weights (n=10) of tomato leaves at 25 and 32 DAS, according to the duration of hydropriming and severity of root pruning (rps 1/3, rps 2/3)

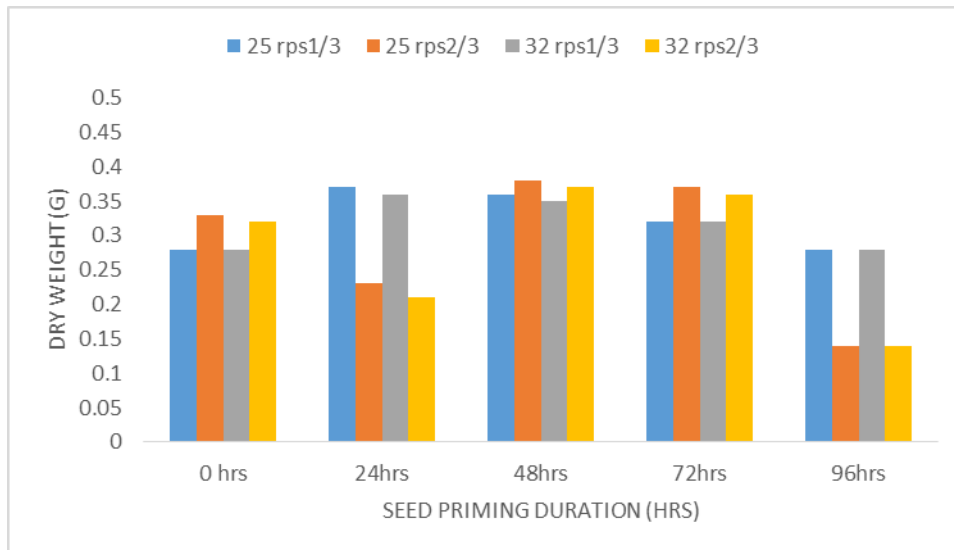


Fig. 2. Mean dry weights (n=10) of tomato stem at 25 and 32 DAS, according to the duration of hydropriming and severity of root pruning (rps 1/3, rps 2/3)

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RESULT

The result of the effect of different duration of hydropriming and pruning of varying severity (nps, rps 1/3 and rps 2/3) on the total plant dry matter (W), and root dry matter (RW) of tomato seedlings 25 and 32 days after sowing (DAS) is shown in Table 1. It could be observed from the data that the combined effect of different duration of hydropriming and root pruning on the growth of tomato seedlings was significant. The total plant dry matter (W) of non-root pruned seedlings (nps) was significantly higher compared with seedlings pruned at 1/3 and 2/3 of their total root system for both 25 DAS and 32 DAS for seeds primed at different duration. Seedlings with two third of their total root system pruned showed a reduced total dry matter compared to less pruned seedlings (rps 1/3) for all seeds primed at different duration irrespective of pruning time while at later pruning time (32 DAS), a significantly smaller dry matter was recorded for pruning methods (1/3 and 2/3 of total root system) for all seeds primed at different duration. Significant differences in terms of root-shoot dry weight ratio have been found among the primed tomato populations pruned for different duration and severity (analysis of variance, not shown) as presented in Table 2 with seeds primed for 96hrs and 48 hrs. The coefficient of variation of root-shoot ratio (%) in the measured traits of tomato seedlings at 25DAS and 32DAS varied between 11-33% and 13-44% respectively. Significant reduction was observed in dry weight of photosynthetic organ (leaf) and non photosynthetic organ (stems) of seeds primed for 96hrs with greater root severity (2/3) irrespective of the difference in days after sowing (Fig 1 and 2).

DISCUSSION

The total plant dry matter and root dry matter was influenced by the duration of priming, severity of pruning, as well as pruning time as shown in Table 1. This result agrees with studies carried out by Balliu et al. (2012) [13] which showed that the “nps” seedlings kept their advantage of higher dry matter (W) and higher root dry matter (RW) irrespective of their pruning condition. Same fact result was shown for the root dry matter of those seedlings (Table 1). Olugbemi et al. (2010) [14] also reported that dry matter (DM) values increased in primed seeds as compared to non primed seeds. The significant increase in mean value of root-shoot ratio as shown in Table 2 with seeds primed for 96 hours closely followed by 48 hours showed that high root plants will absorb more ratio indicating that priming the nutrients from the soil and this will help in increasing above ground biomass. This ratio is often observed to increase under adverse conditions such as drought [15, 16, 17]. For both leaf and stem weight, the variation in the magnitude of the response to combined treatment suggests that physiological mechanisms are active.

CONCLUSIONS

Hydropriming and root pruning has an adverse effect on growth of tomato seedlings. At the end of the nursery period, the total plant dry matter (W) of non pruned seedlings (nps) was significantly higher compared with root pruned (at 25 DAS and 32 DAS) seedlings. At 25 DAS and 32 DAS, the total

plant dry matter (W) and root dry weight (RW) of non- root pruned seedlings (nps) was significantly higher compared with root pruned seedlings. The effect of different duration of hydro priming also significantly affected the root shoot ratio, leaf and stem weight of all pruned seedlings.

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